A PERIPHERAL DEVICE FOR A DATA PROCESSING SYSTEM

Technical field

The present invention relates to the computer field, and more specifically to a peripheral device for a data processing
5 system.

Background art

A peripheral device is a hardware unit that is used to interact with a data processing system, such as a Personal Computer (PC); particularly, input devices allow a user to
10 enter data and/or commands into the computer, whereas output devices provide information to the user.

A keyboard is one of the most common input devices. The keyboard consists of a set of mechanical buttons (keys), which are pressed by the user to enter information into the
15 computer. The keys are arranged to resemble a typewriter keyboard, with a few extra keys for computer commands and a numeric keypad.

A drawback of the keyboards known in the art is that they are very often ineffective to meet the input needs of several
20 applications running on the computer. As a matter of fact, although the function and the position of the keys may be configured by software, the shape and the size of the keys are

imposed by the hardware layout of the keyboard and cannot be changed in any way.

In order to solve this problem, alternative input devices have been proposed in the last years for specific
5 applications. For example, a console with a joystick is commonly used for computer games; moreover, a touch-screen enables the user to enter and display information on the same device in kiosks providing several types of computer-related services (such in an Automated Teller Machine, or ATM).
10 However, each alternative input device is commonly designed for a specific application. This causes the proliferation of a number of different input devices; moreover, the connection of each input device to the computer is quite complex, and involves waste of time and space. As far
15 as the touch-screen is specifically concerned, although it may be configured to provide a natural interface for computer novices, it is unsatisfactory for several applications. As a matter of fact, most users find the touch-screen tiring to the arms after long use; in any case, the standard keyboard is far
20 and away preferred when working with applications doing ordinary computing work.

Summary of the invention

It is an object of the present invention to provide a peripheral device, which can be used either as a standard
25 keyboard or as an alternative input device.

It is another object of the present invention to avoid proliferation of different input devices.

It is yet another object of the present invention to provide a peripheral device that may be configured for
30 specific applications in a simple manner.

The accomplishment of these and other related objects is achieved by a peripheral device for a data processing system including a mechanical keyboard having a plurality of keys for entering information into the data processing system when the

keys are pressed, wherein the peripheral device further includes a configurable unit for displaying a visual representation of a plurality of further keys for entering information into the data processing system when the further

5 keys are selected.

The present invention also provides a data processing system including the peripheral device, and a corresponding method of operating the data processing system.

The novel features believed to be characteristic of this

10 invention are set forth in the appended claims. The invention itself, however, as well as these and other related objects and advantages thereof, will be best understood by reference to the following detailed description to be read in conjunction with the accompanying drawings.

15 **Brief description of the drawings**

Figures 1a-1b	are a pictorial representation of a desktop in which the peripheral device of the invention can be used;
Figures 2a-2b	show the peripheral device in different positions;
Figures 3a-3c	are partially cut away, side elevation views of a notebook including a further embodiment of the peripheral device;
Figures 4a-4b	depict different enlarged particulars of the notebook;
Figure 5	shows a circuit scheme of a sensor included in the peripheral device;
Figure 6	is a schematic block-diagram of the desktop.

Detailed description of the preferred embodiment

With reference in particular to Figure 1a, a Personal Computer 100 is shown. The computer 100 consists of a desktop

(typically used at the office or at home), which is designed to fit comfortably on top of a desk 103. The desktop 100 is formed by a central unit 105 housing the electronic circuits controlling its operation. A monitor 115 and a mouse 120 are
5 connected to the central unit 105 in a conventional manner.

A peripheral device 125 is further plugged into a port of the central unit 105 (not shown in the figure). The peripheral device 125 includes a mechanical keyboard 130. The keyboard 130 consists of a set of mechanical buttons (keys) 135, which
10 are pressed by a user to input information into the desktop 100; typically, the keys 135 are classified as alphanumeric keys (letters and numbers), punctuation keys (comma, period, semicolon, and so on), and special keys (function keys, control keys, arrow keys, Caps Lock key, and so on).

15 When the peripheral device 125 is turned upside down, as shown in Figure 1b, the user is provided with a touch-screen 140. The touch screen 140 consists of a display screen that is sensitive to human touch (for example, implemented with a resistive, a surface wave or a capacitive technology). The
20 touch-screen 140 displays a set of objects 145 (such as geometrical figures), each one representing a virtual key. When the user touches the keys 145 with his/her finger, the corresponding information is entered into the desktop 100; optionally, the selected key flashes and/or a brief synthetic
25 beep is output.

As described in detail in the following, the touch-screen is dynamically configured according to the current input need of the desktop 100. For example, the touch-screen displays a colored console with fire and direction keys when playing
30 games, a browser toolbar when surfing on the INTERNET, a piano keyboard when playing music, a simplified keyboard (with a reduced set of enlarged keys) when used by kids or people with handicap, and so on; moreover, keys are made to blink so as to prompt their selection (for example, in an interactive
35 course). The touch-screen 140 may also be used to display a pop-up menu with selectable commands, or a secondary

operational screen (such as a calculator when a spreadsheet is opened).

A portion of the touch-screen 140 defines a window 150 for displaying output information and/or for replicating the

5 information entered by the user; preferably, additional output information is displayed in the background (below the keys 145 and the window 150). For example, a calendar is opened when an e-mail application is started, or advertisement banners are displayed when a web site is accessed.

10 Similar considerations apply if the desktop has a different structure or includes other units, if the desktop is replaced with an equivalent data processing system (such as a workstation), if the keyboard has a different layout or is of a different type (for example, a membrane keyboard with the

15 keys covered by a transparent, plastic shell), if the output information is displayed in two or more windows, if no information is provided in the background, and the like.

Considering now Figure 2a, the peripheral device 125 has a main body formed by a thin box 205 (for example, made of

20 plastic material). The box 205 has two opposed main surfaces 210 and 215; the surface 210 carries the keyboard (with its keys 135), whereas the surface 215 carries the touch-screen. In the position shown in the figure (corresponding to Figure 1a), the surface 215 rests on the desk 103; as a consequence,

25 the surface 210 is turned upwards so that the keyboard is accessible to the user. Two wings 225a and 225b are hinged along lateral edges of the surface 210; the wings 225a,225b are folded on corresponding sidewalls of the box 205.

Moving to Figure 2b, the peripheral device 125 is

30 inverted (to the position shown in Figure 1b); the surface 215 is then turned upwards, so that the touch-screen is accessible to the user. In this case, the wings 225a,225b are unfolded until they project downwards (perpendicularly to the surface 210). The wings 225a,225b are higher than the keys 135; as a

35 consequence, the keys 135 are spaced apart from the desk 103 so as to prevent their pressure.

Similar considerations apply if the peripheral device has a different structure, if the peripheral device rests on another bearing surface, if the wings are replaced with a set of foldaway pins (or other equivalent spacing means), and the

5 like.

In an alternative embodiment of the invention, as shown in Figure 3a, the proposed solution is embedded in a notebook 300; the notebook 300 consists of a portable computer, which is extremely lightweight and is small enough to fit easily in

10 a briefcase. The notebook 300 is formed by a case 305 housing its central unit; the display is integrated in a panel 310, which is hinged to the case 305 at a rear edge thereof (opposed to a front edge facing a user of the notebook 300).

The case 305 includes a housing 315 (closed by the

15 display panel 310 when folded down the case 305) for a peripheral device 320 similar to the one described above. The peripheral device 320 is formed by a panel 325 having two opposed main surfaces, which carry a mechanical keyboard 330 and a touch-screen 335, respectively. Two pegs 340 extend

20 laterally, near an internal edge of the panel 325. The pegs 340 slide along two guides 345 that are arranged on internal sidewalls of the housing 315 (extending transversally to the display panel 310); at the same time, the pegs 340 allow the panel 325 to pivot around the case 305.

25 A pair of catches 350f and a pair of catches 350r are provided on the case 305; the catches 350f are placed near a front end of the guides 345, whereas the catches 350r are placed near a rear end of the guides 345. A pair of recesses 355k is formed in the panel 325 (near its external edge) on

30 the side of the keyboard 330; a pair of recesses 355t is likewise formed in the panel 325 (near its external edge) on the side of the touch-screen 335. As described in detail in the following, the catches 350f engage the recesses 355t or the catches 350r engage the recesses 355k (according to the

35 position of the peripheral device 320). At the same time, the catches 350r are received in mating grooves 360t that are

formed in the panel 325 (near its internal edge) on the side
of the touch-screen 335, or the catches 350f are received in
mating grooves 360k that are formed in the panel 325 (near its
internal edge) on the side of the keyboard 330.

5   As shown in the figure, the internal edge of the panel
325 is pushed towards the rear end of the guides 345 (acting
as an end of stroke). The panel 325 is then folded down the
case 305. As a consequence, the panel 325 is latched in a
position with the keyboard 330 turned upwards (so as to be
10 accessible to the user).

Moving now to Figure 3b, the user unlatches the panel 325
from the case 305. The panel 325 is unfolded, and its internal
edge is pulled towards the front end of the guides 345 (acting
as a further end of stroke). The panel 325 is then folded down
15 the case 305 and latched in a position with the touch-screen
335 turned upwards, so as to be accessible to the user.

Similar considerations apply if the notebook has a
different structure or is replaced with another data
processing system (such as a palm-top), if the guides are
20 arranged parallel to the display panel, if the pegs and the
guides are replaced with a wheel mechanism or other equivalent
means for sliding and pivoting the panel, and the like.

The structure of the catches 350f,350r is shown in
greater detail in Figures 4a and 4b (wherein Figure 4a
25 includes a cross-section view along a plane parallel to the
display panel and passing through the catch 350f, and wherein
Figure 4b includes a plan view and a cross-section view along
a plane parallel to the display panel and passing through the
catch 350r). Each catch 350f,350r has a push button 405f,405r
30 formed by a stem ending with an external head; the stem slides
horizontally in a mating throw hole with a flat seat for
receiving the head. A free end of the stem is up-turned to
define a hook 410f,410r that projects upwards from the case
305. The hook 410f,410r ends with a tooth 413f,413r having an
35 outward lead-in face and a bottom stop face. The hook
410f,410r slides transversally in a corresponding housing; a

spring 415f,415r acts on the hook 410f,410f so as to bias the push button 405f,405r to an extracted position. A complaint peg 420f,420r is further provided near the hook 410f,410r; the peg 420f,420r projects upwards from the case 305, and ends
5   with an inward lead-in face (opposite the internal edge of the panel 325 when moving towards the corresponding end of the guides).

Each recess 355k,355t (see Figure 4a) has a mouth mating the tooth 413f,413r; the mouth is aligned with the housing of
10 the hook 410f,410r when the panel 325 is folded down the case 305. The recess 355k,355t has a larger internal section, which extends outwards to define an undercut acting as an abutment for the stop face of the tooth 413f,413r.

Each groove 360k,360t (see Figure 4b) has a trapezoidal
15 section in plan view. Particularly, an internal end of the groove 360k,360t is aligned with the housing of the hook 410f,410r (when the panel 325 is folded down the case 305). The groove 360k,360t widens towards a corresponding corner of the panel 325, so that a mouth thereof (at the internal edge
20 of the panel 325) encompasses the tooth 413f,413r when the push button 405f,405r is in the extracted position; a sloped lateral surface joints the smaller end with the larger end of the groove 360k,360t.

When the panel 325 is folded down the case 305 (with the
25 keyboard turned upwards), the tooth 413r is received in the groove 360t (as shown in Figure 4b). The interference of the sloped surface of the groove 360t with the lead-in face of the tooth 413r pushes the hook 410r inwards, causing the spring 415r to yield resiliently. When the tooth 413r reaches the
30 smaller end of the recess 360t, the push button 405r is in a completely retracted position. Moreover, the panel 325 acts on the lead-in face of the peg 420f so as to cause its lowering.

At the same time, the interference of the panel 325 with the lead-in face of the tooth 413f pushes the hook 410f
35 inwards (as shown in Figure 4a). When the panel 325 is pressed against the case 305, the tooth 413f is received into the

recess 355t. As soon as the tooth 413f emerges from the mouth of the recess 355t, the larger portion of the recess 355t clears the tooth 413f causing the spring 415f to push the hook 410f outwards (until the head of the push button 405f is

5 completely extracted). As a consequence, the stop face of the tooth 413f abuts against the undercut of the recess 355t, thereby latching the panel 325 and the case 305 together. Moreover, the panel 325 also acts on the lead-in face of the peg 420f so as to cause its lowering.

10 When the user needs to invert the peripheral device, he/she presses the push buttons 405f. As a consequence, the stop face of each tooth 413f clears the undercut of the recess 355t, so as to unlatch the panel 325 from the case 305. The pegs 420f raise the panel 325, allowing the user to grab its

15 external edge. The same operations described above are then repeated on the other side, until the panel 325 is folded down the case 305 (with the touch-screen turned upwards).

Similar considerations apply if the catches have a different structure (for example, with sliding commands

20 instead of the push buttons), if the hooks are replaced with other locking elements, or more generally if equivalent means are used to latch the panel and the case together, if a pair of handles is provided for pulling the panel (eliminating the need of the complaint pegs), if a different mechanism is

25 envisaged for keeping the push buttons flush with the case (when the corresponding hooks are non-operative), or if equivalent means are provided for indicating the catches currently latching the panel and the case together (for example, using a series of LEDs).

30 Considering now Figure 5, the peripheral device described above (either in the desktop or in the notebook) is provided with a sensor 500 for detecting its position. The sensor 500 if formed by a bulb 505, which is filled with a liquid having a relatively high viscosity (but that is not electrically

35 conductive). A metallic ball 510 slides downwards inside the bulb 505 under the force of gravity.

A pair of metallic terminals 515k and 520k crosses a base of the bulb 505 (in the lower position when the peripheral device has the keyboard turned upwards); a pair of further metallic terminals 515t and 520t crosses an opposed base of the bulb 505 (in the upper position). The terminals 515k and 515t are connected to a reference terminal (or ground). The terminal 520k is connected to a first terminal of a resistor Rk, and the terminal 520t is connected to a first terminal of a resistor Rt. Both the resistors Rk and Rt have a second terminal that is connected to the positive terminal of a direct-voltage power supply +Vcc (for example, 5V), whose negative terminal is connected to the ground terminal.

The terminal 520k and the terminal 520t are further connected to the inverting input (-) and to the non-inverting input (+), respectively, of a comparator 525. The comparator 525 outputs a signal KB; the signal KB is asserted (at the voltage +Vcc) when the voltage at the non-inverting input is higher then the voltage at the non-inverting input, whereas the signal KB is deasserted (at the voltage 0V) otherwise. The comparator 525 has a hysteresis characteristic, so as to filter spurious signals (for example, due to a jolt of the peripheral device). The signal SB is provided to an inverter 530, which outputs a signal TS=KB.

In the position shown in the figure (keyboard turned upwards), the ball 510 short-circuits the terminals 515k and 520k. The voltage at the non-inverting input of the comparator 525 is then kept at +Vcc, whereas the voltage at its inverting input is brought to ground; as a consequence, the signal KB is asserted (and the signal TS is deasserted). Conversely, if the peripheral device is inverted (with the touch-screen turned upwards) the ball 510 short-circuits the terminals 515t and 520t. The voltage at the inverting input of the comparator 525 is then kept at +Vcc, whereas the voltage at its non-inverting input is brought to ground; as a consequence, the signal KB is deasserted (and the signal TS is asserted).

Similar considerations apply if the sensor has a different structure (for example, with a micro-machined element integrated in a chip of semiconductor material or with a pair of simple switches), or if equivalent means are

5 provided for detecting the position of the peripheral device.

Moving now to Figure 6, a schematic block-diagram of the desktop 100 is shown (similar considerations apply to the notebook). The central unit 105 has an architecture based on a communication bus 605, to which the different components of

10 the central unit 105 are connected in parallel. In detail, a microprocessor (μP) 610 controls operation of the desktop 100, a DRAM 615 is directly used as a working memory by the microprocessor 605, and a Read Only Memory (ROM) 620 stores basic code for a bootstrap of the desktop 100. The central

15 unit 105 further includes a magnetic hard-disk 622 (embedding a respective controller), a driver 625 for reading CD-ROMs 627, a controller 630 for the mouse 120 and a controller 635 for the monitor 115.

The peripheral device 125 has an internal controller 640

20 for the keyboard 130 and an internal controller 645 for the touch-screen 140. The sensor 500 enables the keyboard internal controller 640 or the touch-screen internal controller 645 in mutual exclusion; for this purpose, the signal KB is supplied to an enabling pin of the keyboard internal controller 640,

25 whereas the signal TS is supplied to an enabling pin of the touch-screen internal controller 645. The keyboard internal controller 640 directly interfaces with a corresponding external controller 650, which is connected to the bus 605 in the central unit 105; the touch-screen internal controller 645

30 likewise interfaces with an external controller 655 (connected to the bus 605 as well).

During operation of the desktop 100, programs and data (which have been installed onto the hard-disk 622 from CD-ROM 627) are typically loaded (at least partially) into the

35 working memory 615. Particularly, a driver 660 controls the keyboard 130, whereas a driver 665 controls the touch-screen

140. The keyboard driver 660 and the touch-screen driver 665 communicate with one or more application programs 670; the application programs 670 interface with a screen buffer 675 for the monitor 115.

5   When the keyboard 130 is turned upwards, the keyboard internal controller 640 is enabled by the signal KB (while the touch-screen internal controller 645 is disabled by the signal TS). If a current application program 670 requires the use of the touch-screen 140, the application program 670 prompts the

10 user to invert the peripheral device 125 (with a message displayed on the monitor 115). As soon as the touch-screen 140 is turned upwards, the touch-screen internal controller 645 is enabled by the signal TS (while the keyboard internal controller 640 is disabled by the signal KB). The application

15 program 670 then controls the configuration of the touch-screen 140 through corresponding output instructions; the output instructions are provided to the touch-screen driver 665, which translates them into corresponding commands for the touch-screen controllers 655,645.

20   In every case, whenever the user selects a key (with the keyboard 130 or the touch-screen 140) the enabled internal controller 640 or 645 sends a corresponding scan code to the driver 660 or 665, respectively. The driver 660,665 translates the scan code into an instruction for the application program

25 670, which controls the screen buffer 675 accordingly.

     Similar considerations apply if the desktop has a different architecture, if all the controllers of the keyboard and the touch-screen are integrated in the central unit, if equivalent software modules are provided, and the like.

30   More generally, the present invention proposes a peripheral device for a data processing system. The peripheral device includes a mechanical keyboard; the mechanical keyboard has a plurality of keys for entering information into the data processing system when the keys are pressed. The peripheral

35 device of the invention further includes a configurable unit for displaying a visual representation of a plurality of

further keys; the further keys are used for entering information into the data processing system when they are selected.

The solution of the invention provides a peripheral
5 device that can be used as a standard keyboard, when working with applications doing ordinary computing work; at the same time, the peripheral device can be used as an alternative input device, so as to meet the input needs of different applications.

10   This result is achieved without any proliferation of different input devices, thereby saving time and space.

The proposed solution allows the peripheral device to be configured for specific applications in a very simple manner.

The preferred embodiment of the invention described above
15 offers further advantages.

For example, the configurable unit consists of a touch-screen.

This allows the user to work with both input units (the keyboard and the touch-screen) in a very similar manner.

20   Advantageously, the keyboard and the touch-screen are arranged on opposed surfaces of the peripheral device.

The proposed structure does not require any additional space for the touch-screen.

Preferably, means are provided for spacing the keys apart
25 from a surface bearing the peripheral device.

This feature prevents any pressure of the keys when using the touch-screen.

Alternatively, the peripheral device includes a tablet (wherein the keys are selected with a pen), a standard screen
30 with an integrated touchpad (that is used to move a pointer on the screen for selecting the keys), or an equivalent configurable unit, no spacers are provided for the keys, or the keyboard and the touch screen are arranged side-by-side.

In a preferred embodiment of the invention, a switch is
35 used to enable the keyboard or the touch-screen in mutual exclusion.

This avoids any interference between the two input units, and reduces the power consumption of the peripheral device.

As a further improvement, a sensor detects the position of the peripheral device and enables the keyboard or the
5 touch-screen accordingly.

The devised solution makes it possible to switch between the keyboard and the touch-screen automatically (simply turning the peripheral device upside down).

Advantageously, the touch-screen is further used for
10 displaying output information.

This feature reduces the focus changing (between the monitor and the touch-screen) required to the eyes of the user. Moreover, the proposed solution makes it possible to provide information to the user in a very effective manner.

15 However, the solution according to the present invention leads itself to be implemented with both the keyboard and the touch-screen that are always enabled, with a manual switch that must be operated by the user for enabling the keyboard or the touch-screen, or even without displaying any output
20 information on the touch-screen.

The peripheral device of the invention can be used either as an external unit (plugged into a port of the central unit) or as an internal unit (integrated in the central unit).

In the latter case, a guide mechanism is preferably
25 provided for sliding and pivoting the peripheral device.

The devised solution is very simple, but at the same time effective.

Advantageously, the peripheral device is latched in its different operative positions.

30 This feature avoids any unwanted movement of the peripheral device.

As a further improvement, a generic indication is provided for identifying the buttons to be operated for unlatching the peripheral device.

35 The proposed characteristic facilitates the operations needed to invert the peripheral device.

Alternatively, another mechanism is used for turning the peripheral device (for example, pivoting the peripheral device around an axis perpendicular to the case), no indication is provided for identifying the buttons to be operated for

5   unlatching the peripheral device, or the peripheral device is held in place only under the force of gravity.

Naturally, in order to satisfy local and specific requirements, a person skilled in the art may apply to the solution described above many modifications and alterations

10 all of which, however, are included within the scope of protection of the invention as defined by the following claims.